

A new species of treehopper in the genus *Cladonota* Stål (Hemiptera: Membracidae: Membracinae: Hypsoprurini) from Costa Rica, with preliminary observations of its behaviour and natural history

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Cladonota Stål is a genus of Neotropical treehopper found throughout much of South America, Central America, and as far north as Mexico (Godoy et al. 2006). Whilst many membracids are known to exhibit extravagant pronotal expansions (Buckton 1903), the morphologies found within *Cladonota* are arguably some of the most extreme, making them a particularly charismatic taxon. The function most frequently proposed for the shape of the *Cladonota* pronotum is camouflage; in particular, masquerade mimicry of dry leaf or bark fragments (Godoy et al. 2006; Swing 2012). However, this mimetic function remains to be empirically tested.

The genus *Cladonota* is divided into four subgenera: *Cladonota* Stål, *Falculifera* McKamey, *Lecythifera* Fowler, and *Lobocladisca* Stål. A key to these subgenera can be found in Flynn (2018), and two of these subgenera, *Falculifera* (Flynn 2018) and *Cladonota* (Flynn 2019), have recently been reviewed. Distinguishing between these subgenera and their comprising species relies upon morphological characters of the pronotum, face, legs, and wings, as comparing genitalia has not proven effective (Flynn 2018). *Falculifera* is the least speciose of the subgenera, with only seven described species before the inclusion of *Cladonota rex* England **sp. nov.**

The holotype was examined with a Leica MZ16 stereomicroscope (Leica Microsystems GmbH, Wetzlar, Germany), lit by a dual source LED lighting system (Brunel Microscopes Ltd., Chippenham, United Kingdom). Field photographs were taken with an AF-S DX Micro NIKKOR 85mm f/3.5G ED VR lens mounted on a Nikon D3400 DSLR camera (Nikon Corporation, Tokyo, Japan); settings: f/11, 1/125 s exposure, ISO variable. Holotype is to be deposited in the Museo de Zoología, Universidad de Costa Rica, San Pedro, Costa Rica (MZUCR). Definitions of descriptive terminology can be found in Flynn (2018).

Cladonota (Falculifera) rex England **sp. nov.**

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Diagnosis. *Cladonota rex* can most easily be distinguished from other members of the genus *Cladonota* by the unique and distinctive yellow-green ‘saddle’ located between the posterior and anterior pronotal processes, in combination with the open C-shaped pronotum (lack of both an intermediate process and a projection on the posterior edge of the anterior process) exhibiting concave regions on both the posterior and anterior process.

Description. Male: unknown. Holotype female (Figures 1–4):

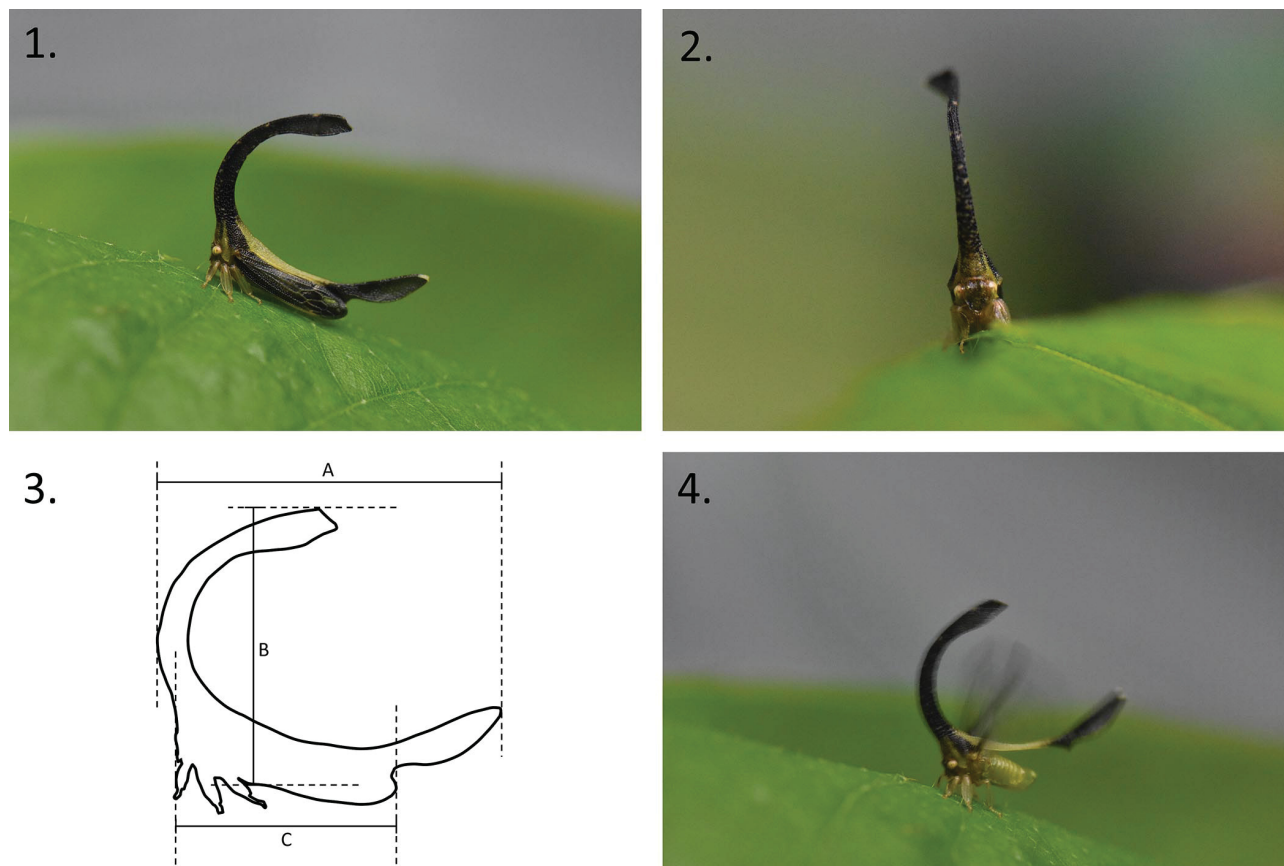
Head: trilobed (supra-antennal lobes and clypeus). Clypeus rounded and pilose at the tip. Ocelli located closer to their nearest compound eye than to each other and lie above the centro-ocular line. Metopidium angled slightly forward from the face, blending into anterior process.

Thorax: Pronotum greatly expanded, with arching anterior and posterior processes that together form a C-shape. No intermediate process or projection on posterior edge of anterior process. Dorsal half of anterior process slightly sinuous in dorso-anterior view. Apex of anterior process split bilaterally into a Y-shape. Posterior process extends significantly further than the apex of the forewings at rest. Entirety of posterior process, and approximately the distal third of anterior process, have slightly concave sides. Vast majority of pronotum heavily punctate, with punctations becoming wider and shallower distally. Each punctation contains a single seta. Erect setae found along the ridges of both pronotal processes. Legs all with foliaceous tibia.

Forewings: Proximal regions of the forewings punctate and coriaceous. Punctations also each contain a single seta. Apical limbus broad and wrinkled. Veins predominantly hyaline but dark in places.

Colour: Ocelli pale yellow with darker centres. Compound eyes yellow with darker striations. Pronotum predominantly dark brown to black, with a large ‘saddle’ region of yellow-green between the anterior and posterior processes, and small intermittent specks of green on the anterior process. Yellow-green streaks, with acute apices, immediately adjacent to the distal edge of compound eyes. Posterior process with small white patch at tip. Metopidium largely yellow-green with small dark patches. Legs, abdomen, and underside of thorax all yellow-green in colour. Forewings dark brown, except for translucent segments in entirety of the 2nd apical cell and a smaller region on 3rd apical cell, as well as two on apical limbus, at posterior and dorsal most points.

Measurements (Fig. 3): face to posterior tip of forewings—6 mm, dorsal edge of anterior process to ventral edge of abdomen beneath humeral angles—9 mm, anterior most edge of anterior process to posterior most edge of posterior process—11 mm.



FIGURES 1–4. Images of *Cladonota rex* England **sp. nov.** 1: Lateral view photograph of live specimen. 2: Anterior view photograph of live specimen. 3: Illustration of measurements given in description, A=11 mm, B=9 mm, C=6 mm. 4: Photograph showing potentially defensive wing-buzz by live specimen.

Natural history and behaviour: Knowledge of the natural history and behaviour of *C. rex* is clearly limited because only a single specimen has been found thus far. However, some preliminary observations were made. The holotype was found stationary on the underside of a leaf near the top of a *Piper* sp. plant approximately three metres tall. The plant itself was situated on the bank of a small river, about one metre from the water’s edge. It was not clear as to whether the *C. rex* individual was feeding on *Piper* sp., and therefore it cannot be confirmed as a true host plant; however, due to the amount of time the individual remained stationary, some association likely exists. There were no other *C. rex* individuals found nearby, indicating that, like other *Cladonota* species (Lin 2006; Godoy et al. 2006), *C. rex* is solitary in adulthood. Planthopper nymphs (infraorder Fulgoromorpha) were located on the same leaf as the *C. rex* individual but no obvious species interaction was evident. A single ant (*Tapinoma* sp.) was observed approaching the *C. rex* individual and probing and tapping the treehopper’s face, near the antennae. This seemingly prompted the treehopper to lift the posterior process of the pronotum away from the abdomen and buzz its wings (Fig. 4). The ant immediately fled. Together these observa-

tions indicate that *C. rex*, and likely other *Cladonota* species, use wing-buzzes as a deterrent to attention from ants and possibly other unwanted mutualists or predators.

Distribution: Known only from the type locality in Costa Rica.

Material examined: Holotype female from COSTA RICA (MZUCR). With labels: “COSTA RICA. Heredia Province, La Selva Bio. Station / 10.4337°N, 84.0080°W, 60m. On *Piper* sp. / 27.Jun.2019. S. J. England” and red holotype label “HOLOTYPE / *Cladonota rex* / England”.

Etymology: the species name *rex* is given in honour of the immense contributions of Reginald “Rex” B. Cocroft to humankind’s understanding of treehopper behaviour and ecology. It is utilised as a noun in apposition. **Discussion:** The setae associated with pronotal pits appear to be sensory in function, as has been previously suggested in other treehopper genera (Wood & Morris 1974; Wood 1975; Dietrich 1989; Stegmann 1998).

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